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Simulation of Reactive Power Compensation by SVC on Three Phase Transmission Line

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ABSTRACT

A Reactive power is a part of apparent power which flow with active power. A low value of power factor requires large reactive power and this affects the voltage level. Hence in order to compensate for the reactive power, the power factor of the system must be improved. Thus, the methods for reactive power compensation are nothing but the methods by which poor power factors can be improved. To improve this reactive power FACT device named Static VAR Compensator (SVC) is used. With the help of MATLAB simulation we observed the voltage Sag and Swell conditions occurred in Transmission line and how SVC improve the Transmission line performance was observed.

KEYWORDS: *SVC, Reactive Power, Voltage Sag, Voltage Swell*

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I. INTRODUCTION

Reactive power is known as the amount of power that remains unused and gets generated within an Alternating current circuit or by the reactive components. This is sometimes called imaginary power. A Reactive Power supplies the amount of power back to the supply which it has consumed thus, the average consumed power of the circuit will be zero. Reactive power gets energy moving back into the grid during the passive phases. It is the part of complex power that corresponds to storage and retrieval of energy rather than consumption. On an AC power system, there are two kinds of power - real power that actually does work, and reactive power that enables transformers to transform, generators to generate, and motors to rotate.

The Reactive power is need to be flow with active power. Reactive power can be leading or lagging. While it is the active power that contributes to the energy consumed, or transmitted, reactive power does not contribute to the energy.

Reactive power is either generated or consumed in almost every component of the system, generation, transmission, and distribution and eventually by the loads. The impedance of a branch of a circuit in an AC system consists of two components, resistance and reactance. Reactance can be either inductive or capacitive and must be supplied with lagging reactive power. It is economical to supply this reactive power closer to the load in the distribution system.

A low value of power factor requires large reactive power and this affects the voltage level. Hence in order to compensate for the reactive power, the power factor of the system must be improved. Thus, the methods for reactive power compensation are nothing but the methods by which poor power factors can be improved. The methods are as follows:

- Using capacitor banks
- Using synchronous condensers
- Using static VAR compensators

II. Static VAR compensator

The high voltage power system makes use of a static VAR compensator. It is abbreviated as SVC andshows improved system stability, reduction in line losses, and maintaining the variation within limits. It has shunt reactors and shunt capacitors. Shunt reactors and thyristor-controlled reactors are used for limiting the

voltage rise at no load or low load conditions while static capacitors and thyristor switched capacitors are used for preventing the voltage sag at peak load conditions.

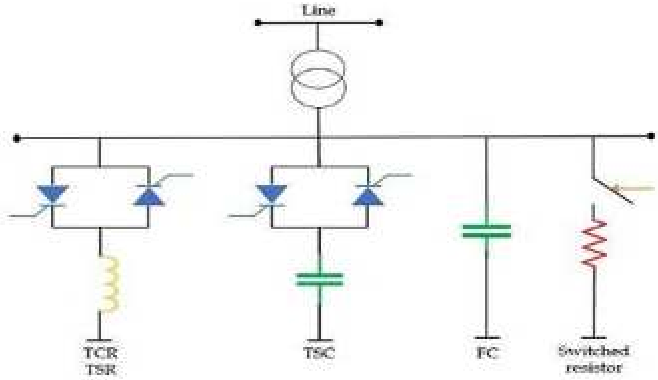
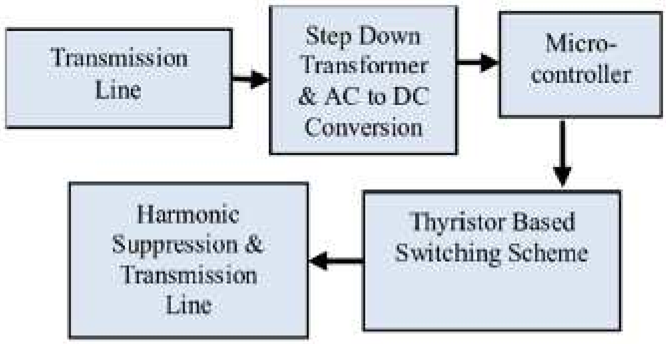


Fig.1 figure of SVC

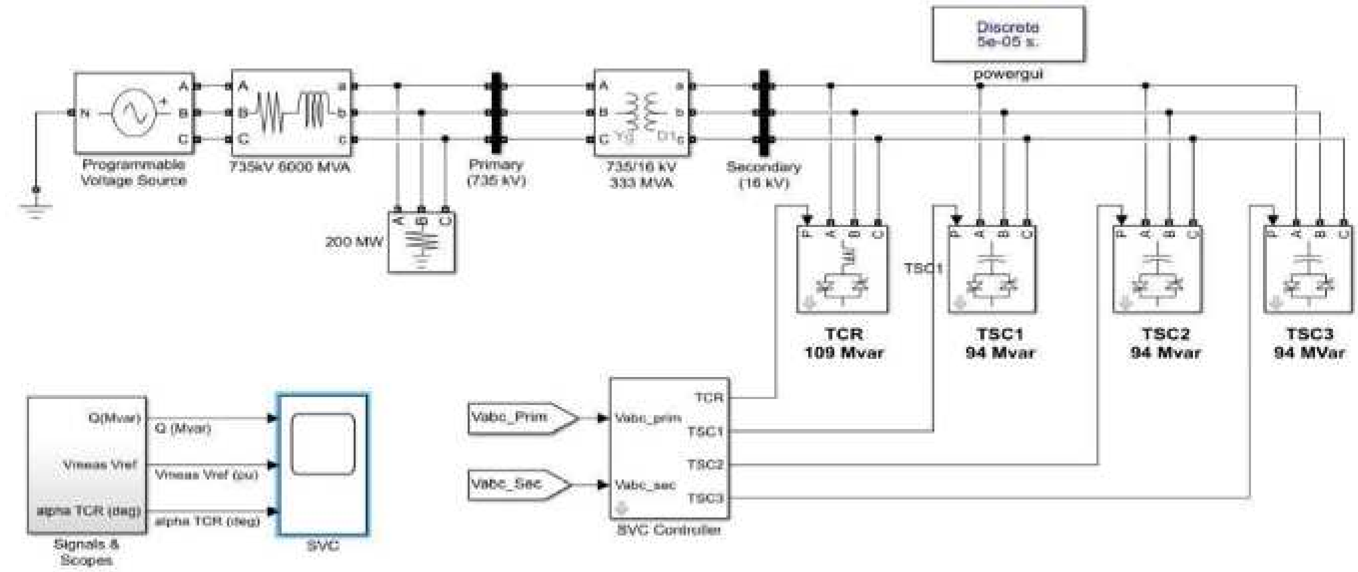
This can be formed in two ways, one with the parallel combination of thyristor controlled reactor and fixed capacitor while the other one is the parallel combination of thyristor switched capacitor and thyristor controlled reactor. SVC is designed to generate as well as absorb reactive power.

A. Working Principle

Static Var Comprises one or more bank of fixed or switched shunt capacitor or reactors, of which atleast one bank is switched by thyristors. An SVC will typically regulate and control the voltage to the required set point under normal steady state and contingency conditions and thereby provide dynamic, fast response reactive power following system contingencies e.g. network short circuits, line and generator disconnections.



B. Block Diagram



III. RESULTS

Here we are considering Reference Voltage value is 1 P.U.

1. Voltage Swell condition:

Table I Voltage Swell Condition

	Without using SVC	With using SVC
Q (MVAR)	-10	-50 (Reactive power Absorb)
V(MEAR) V(ref) V	1.03	1.01
alpha (TCR) deg	90°	150°

Here, Voltage Swell condition occurred therefore Voltage increases above reference value then Reactive Power Absorb by SVC and maintain the voltage to reference value.

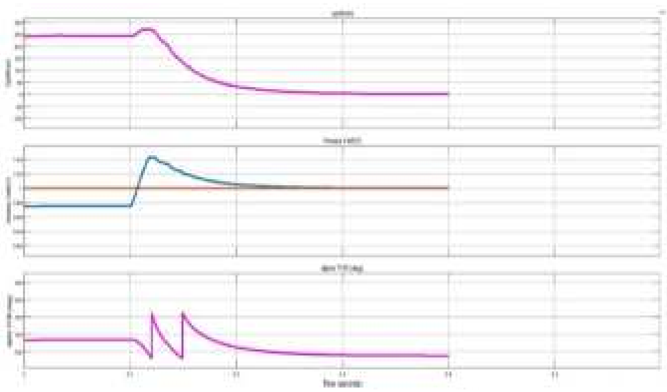


Fig. 2 Graph of Voltage Swell Condition

2. Voltage Sag Condition:

Table II Voltage Sag Condition

	Without using SVC	With using SVC
Q (MVAR)	-50	250
V(MEAR) V(ref) V	0.92	0.98
alpha (TCR) deg	90°	180°

Here, Voltage Decreases below the reference value then Reactive Power Inject by SVC into the transmission line.

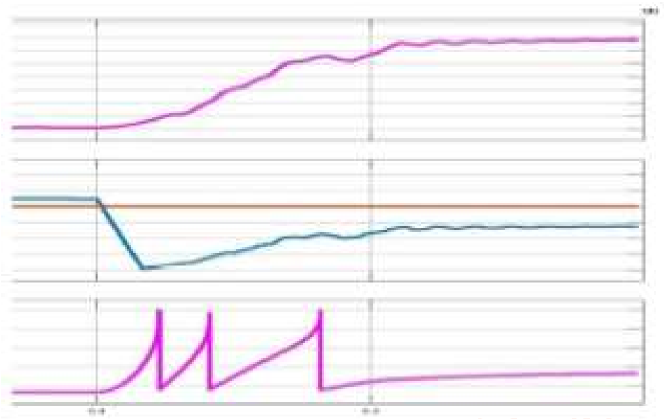


Fig. 3 Graph of Voltage Sag Condition

The Voltage of the programmable voltage source is set to 1 P.U The delayed Firing angle of the thyristor of the TCR branch is alpha 90 degree and measured voltage is 1 PU which does not required RPC.

When t= 0.1sec, the power supply voltage increases To 1.025 P.U . At this time SVC will absorb 95MVAR of RP in order to restore the voltage to the ref voltage. The delay firing angle of voltage Swell and Sag is 90 degree before SVC and swell 150 degree and sag 180 degree with usingSVC. The time required for the measure voltage to return to 1 P.U is about 0.135 sec .

When t=0.4 sec the power supply of the voltage drop to 0.934 P.U at this time SVC will emitted256 MVAR RP in order to restore the voltage to Ref. voltage TCR absorb about 40% of RP and delayedfiring angle of the thyristor of the TCR branch is alpha 120 degree .

IV. OBSERVATION

- Reactive power is used to provide the voltage levels necessary for active power to do useful work. Reactive power is essential to move active power through the transmission and distribution system to the customer.
- The main advantage of SVCs over simple mechanically switched compensation schemes is their near- instantaneous response to changes in the system voltage. For this reason they are often operated at close to their zero-point in order to maximize the reactive power correction they can rapidly provide when required.
- They are generally in higher-capacity, faster and more reliable than dynamic compensation schemes such as synchronous condensers. However, static VAR compensators are more expensive than mechanically switched capacitors, so many system operators use a combination of the two technologies (sometimes in the same installation), using the static VAR compensator to provide support for fast changes and the mechanically switched capacitors to provide steady-state VARs.

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